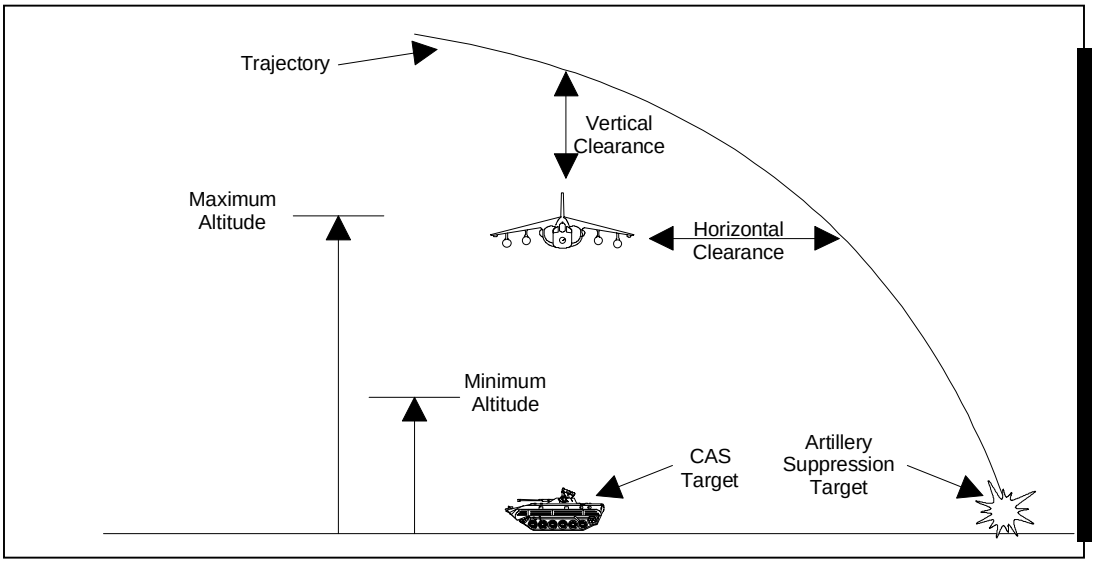
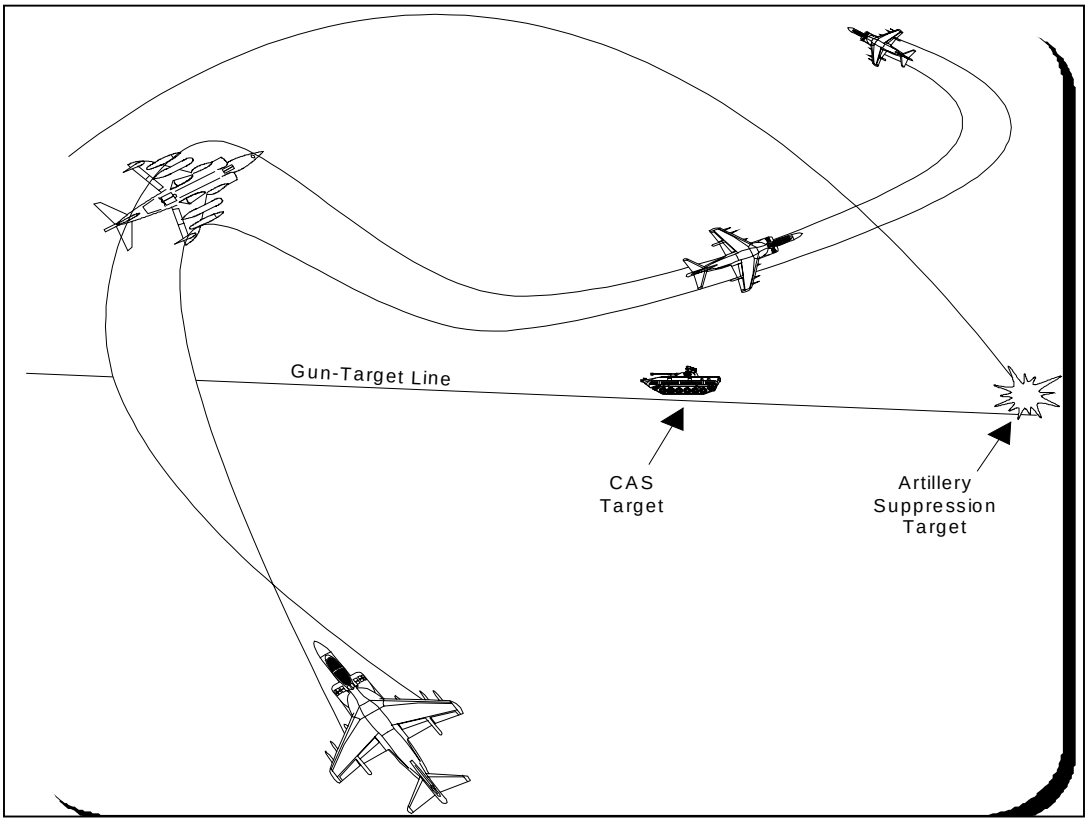
4. **Altitude and Lateral Separation (Closely Adjacent Targets).** Altitude and lateral separation plans are the most restrictive. These plans provide for SEAD when the CAS target is between the indirect fire weapon and enemy AA positions. As shown below, the vertical restriction is a maximum altitude directly over the CAS target and under the GTL. This restriction provides both horizontal and vertical clearance. The aircraft needs to know the minimum altitude of the trajectory over the target. To avoid the indirect fires, aircraft must remain well below this altitude when near the GTL. Normally, aircraft will restrict their attack headings to within 45° of a line perpendicular to the GTL.





Other Coordination of Air Support. In addition to the coordination of CAS with SEAD and marking support, there are other forms of air support that require coordination.

Helicopter Operations. Helicopter operations on the battlefield require coordination. This includes helicopters employed to provide assault support, rotary wing CAS, aerial observers, and MEDEVAC. Helicopter flights and indirect fires must be deconflicted. Procedures used to coordinate these operations include:

w **Helicopter Approach and Retirement Lanes.** These may serve a dual purpose as designated ACAs for the period they are actually in use by in-flight helicopters.

w **Holding Area (HA).** HAs may be established throughout the battlefield to be used for helicopters awaiting targets or missions. These HAs serve as informal ACAs while they are in use. HAs provide the helicopter an area and altitude. HAs may be established during planning, referred to by name or number, and activated/established during operations.

w **Attack Position (AP).** The AP is a maneuvering area which contains firing points for attack helicopters. Like HAs, APs serve as informal ACAs while they are in use. The planning and methods of establishment are also similar to that conducted for HAs.

Answer the following questions.

1. What is the goal for integrating air with surface fire support?

2. What is the primary objective of SEAD?

3. What are the two types of timing sequences for SEAD fires?

4. What are the four types of SEAD separation plans?

Answers.

1. The goal is to integrate air with the other supporting arms and with maneuver to achieve the effect desired from the air strike without suspending the use of the other supporting arms or unnecessarily delaying the scheme of maneuver. An additional goal is to offer a reasonable measure of protection to the aircraft from the unintended effects of our own surface fire.

2. The primary objective of SEAD is to increase air, land, and naval operations by reducing enemy surface-to-air defense capabilities, thereby increasing survivability of air resources.

3. continuous and interrupted

4. lateral separation (adjacent targets)
   altitude separation (same target)
   time separation (same target)
   altitude and lateral separation (closely adjacent targets)

Target List Worksheet

The target list worksheet is a document which facilitates fire planning by the FSC. It is a preliminary listing of all targets and their descriptions from which the FSC can select and plan.

TARGET LIST WORKSHEET

SHEET____OF____

LINE NO	TARGET NO	DESCRIPTION	LOCATION	ALTITUDE	ATTITUDE	SIZE LENGTH	SIZE WIDTH	SOURCE ACCURACY	REMARKS	GP12A3	GP22A3	SE12A3
1	AC2000	EN PLT IN TRENCH	TT 357592	440	2400	300						X
2	AC2001	BN ASSEMBLY AREA	TT 723464	480			1000				X	X
3	AC2002	POL SITE	TT 738575	430	1100	400	200		HE/WP			X
4	AC2003	BN CP	TT 725458	490							X	X
5	AC2004	ZSU 23-4	TT 728461	500						X	X	X
6	AC2005	D30 BATTERY	TT 769541	420						X	X	X
7												
8												
10												
11												
12												
13												
14												
15												

Target Number. Assign each target a target number from the block of numbers given to the planning source. This example is 1st BN, 3d MAR

Description. Use the best available target description. This is key for determining the right ammunition requirements and firing agencies.

Location and Altitude. Determine grid (at least 6 digits) and altitude (always in meters) as accurately as possible. Grid zone may be required if operating off multiple map sheets.

Line No. An administrative control measure for internal use for transmitting data by radio/wire. Each target is assigned a line number. Line numbers are assigned consecutively from page to page.

Attitude. Attitude is the orientation of a linear or rectangular target on the ground. It is always a direction in mils. Attitude is always between 0-3199 mils. Determination to the nearest 100 mils is sufficient.
0 mils = N or 0 degrees,
1600 mils = E or 90 degrees,
3200 mils = S or 180 degrees
4800 mils = W or 270 degrees

Size.
Point Target: no dimensions
Linear Target: length only
Rectangular target: length and width
Circular Target: width (radius) only

Remarks. Additional target description or specific ammunition.

These columns are used to help in planning fires in a schedule. When creating the target list, place a "/" in the block opposite the target if it is to be fired in a schedule. Once it has been scheduled (scheduling worksheet), place a "\" in the same box to form an "X".

Given the following target information, complete the target list worksheet on the next page.

1. You are the FSC for 3d Bn, 5th Marines.

2. The operation order you are working under is OPORDER 11-95.

3. The targets identified to support the scheme of maneuver are:

Description	*Location*	*Ammunition*
Tank Plt	TT773281	Engage w/DPICM
Trenchline	TT824315, length 500, attitude 1700	Engage w/VT
Enemy OP	TT725819, reported by patrol	Engage w/50% WP
Road Intersection	TT692591	
Bn Assembly Area	TT779325, length 600, width 300, attitude 2000	
Trenchline	TT779325-779329	Engage w/VT
Hilltop	TT853911	

TARGET LIST WORKSHEET

( )

SHEET____OF____

LINE NO	TARGET NO (a)	DESCRIPTION (b)	LOCATION (c)	ALTITUDE (d)	ATTITUDE (e)	SIZE LENGTH (f)	SIZE WIDTH (g)	SOURCE ACCURACY (h)	REMARKS (i)					

TARGET LIST WORKSHEET

(3d Bn, 5th Mar OPORDER11-95)

SHEET 1 OF 1

LINE NO	TARGET NO	DESCRIPTION	LOCATION	ALTITUDE	ATTITUDE	SIZE		SOURCE ACCURACY	REMARKS
						LENGTH	WIDTH		
1	AE 3000	Tank Plt	773281						DPICM
2	AE 3001	Trenchline	824315		1700	500			VT
3	AE 3002	Enemy OP	725819					Patrol	50% WP
4	AE 3003	Road Intersection	692591						
5	AE 3004	Bn Assembly Area	779325		2000	600	300		
6	AE 3005	Trenchline	779325-779329						VT
7	AE 3006	Hilltop	853911						

Scheduling Rules

Preparation. An intense volume of fire delivered in accordance with a time schedule in support of an attack.

- Three phases - if no specific commander's guidance is given
  Phase I - hostile fire units (artillery, OPs, radars, antiair assets, etc.)
  Phase II - C^2 (CP, supply, logistics, communications, etc.)
  Phase III - front line elements.

- Gaps should be avoided.

- Start and finish with all fire units firing.

- Last target of a phase must be engaged prior or simultaneously with the first target of the next phase.

- Notes annotated in the remarks column are below the last used fire unit line.

- Schedule at the sustained rate of fire.

- Use time lines and dots.

- Use H-hour.

Counterpreparation. Fired when an enemy attack is imminent. Same as preparation except: two phases and no H-hour (fired on-call). Phases I and III are fired together, then Phase II targets are fired. Remember, meet the commander's guidance.

Series. Fired to support a limited attack, final assault, counterattack, phased withdrawal, or other operation requiring a sequenced attack.

- Schedule in sequence as directed by the maneuver commander.

- Gaps are permitted. You need not use all fire units.

- Schedule at sustained rate of fire.

- Targets may be fired as groups or individual targets. Understand the commander's guidance.
- If the guidance is unclear, ask the commander to be specific.

- Remarks and on-call targets are used as in a preparation.

- Use time line and dots.

- Time line begins at 0.

Groups. All targets are fired simultaneously.

- More than one group can be scheduled on the same scheduling worksheet.
- No time line or dots. Targets fired at the maximum rate of fire. This allows to determine how long a battery will take to fire a target within a group.
- Place group designator in parentheses above the group schedule.
- Remarks used as required.

Programs. Targets of a similar nature (i.e., counterfire, SEAD, smoke, illumination, etc.).

- Scheduled at the sustained rate of fire.
- Use time lines and dots.
- Gaps are permitted. Understand the commander's guidance.
- First time line is time 0.

(2d BN, 3D MAR GROUPS) Scheduling Worksheet

Line No	Organ. and Caliber	Fire Unit	GP12A3	GP22A3	Remarks
1	1/12 155mm (T)		**AC2004 12(a)**	**AC2001 48(b)**	
2	1/12 155mm (T)		**AC2005 30(b) & (c)**	**AC2003 18(a)**	
					(a)HE/VT
4					**(b)DPICM**
5					**(c)last round WP**

1. Group name (notice letters).
2. Do not request >2 targets/groups.
3. One firing unit/target.

Since this is a request, do not enter specific batteries. Only enter DS BN. Once approved, the firing units responsible are entered.

1.Targets fired simultaneously in each group.
2.No lines or dots on a group scheduling worksheet.
3. Schedule # of rounds at maximum rate of fire.

Use the remarks column to specify how you want targets engaged. Every target does not require a footnote. If nothing is listed, the battery will determine ammunition selection based on target description from target list worksheet.

Given the following target list worksheet and scheduling worksheet, schedule groups GP13A5 and GP23A5. 1st Bn, 11th Marines is in direct dupport. Engage with 4 battery volleys per target.

TARGET LIST WORKSHEET

(3D BN, 5TH Mar OPORDER 11-95) SHEET 1 OF 1

LINE NO	TARGET NO	DESCRIPTION	LOCATION	ALTITUDE	ATTITUDE	SIZE L	SIZE W	SOURCE a/o ACCURACY	REMARKS		GP13A5	GP23A5		
1	AE 3000	Tank Pit	TT 773281						DPICM		X			
2	AE 3001	Trenchline	TT 824315		1700	500			VT	X				
3	AE 3002	Enemy OP	TT 725819					Patrol	50% WP					
4	AE 3003	Road Intersection	TT 692591											
5	AE 3004	Bn Assembly Area	TT 779325		2000	600	300				X			
6	AE 3005	Trenchline	TT 779325-779329						VT	X				
7	AE 3006	Hilltop	TT 853911											

SCHEDULING WORKSHEET

( )

Line No	Organ. and Caliber	Fire Unit															Remarks

SCHEDULING WORKSHEET

(3d Bn, 5th Mar Groups, OPORDER 11-95)

Line No	Organ. and Caliber	Fire Unit	GP13A5		GP23A5													Remarks
1	1/11 155mm (T)		AE3001 24(a)		AE3000 24(b)													
2	1/11 155mm (T)		AE3005 24(a)		AE3004 24													
																		(a)VT
																		(b)DPICM

SCHEDULING WORKSHEET

(2D BN, 3D MAR SERIES SE12A3)

Since this series is "on-call", begin the line with "0". PREP FIRES are with respect to H-Hour.

Line No	Organization and Caliber	Fire Unit	0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +10	Remarks
1	1/12 155mm (T)		AC2004 18(a) AC2002 6(b) AC2003 18(a) AC2001 24	
2	1/12 155mm (T)		AC2005 24(c) AC2003 12(a) AC2000 6 AC2001 24	
3				(a)HE/VT
4				(b)50% WP
5				(c)last round WP mark

Since this is a request, do not enter specific batteries. Only enter the DS BN.

LINE: represents impacts over a period of time. Plan for: Artillery – 1 rnd/min/gun NGF—20 rnds/mm/tube 81mm – 15 rnds/mm/tube

SHIFT TIME: This is the amount of time necessary for a weapon system to shift to a new target. Plan for 1 min for all weapon systems.

DOT: represents one volley impacting at that time only

Use the remarks column to specify how you want targets engaged. Every target does not require a footnote. If nothing is listed, the battery will determine ammunition selection based on target description from target list worksheet.

Given the following guidance and target list, schedule series SE13A5.

1. The series is on-call.
2. 1st, Bn, 11th Marines is in direct support (use only two batteries).
3. Engagement

Order	How Long	Remarks
1. AE3004	4 min	two batteries
2. AE3000	3 min	one battery
3. AE3002	1 min	one battery
4. AE3005	3 min	one battery
5. AE3001	3 min	two batteries

TARGET LIST WORKSHEET **SE13A5**

(3d Bn, 5th Mar OPORDER 11-95) **SHEET 1 OF 1**

LINE No.	TARGE No.	DESCRIPTION	LOCATION	ALTITUDE	ATTITUDE	SIZE L	SIZE W	SOURCE ACCURACY	REMARKS					
1	AE 3000	Tank Pit	TT 773281						DPICM	X				
2	AE 3001	Trenchline	TT 824315		1700	500			VT	X				
3	AE 3002	Enemy OP	TT 725819					Patrol	50% WP	X				
4	AE 3003	Road Intersection	TT 692591											
5	AE 3004	Bn Assembly Area	TT 779325		2000	600	300			X				
6	AE 3006	Trenchline	TT 779325-779329						VT	X				
7	AE 3006	Hilltop	TT 853911											

SCHEDULING WORKSHEET

( )

Line No	Organ. and Caliber	Fire Unit															Remarks

SCHEDULING WORKSHEET

( )

Line No	Organ. and Caliber	Fire Unit	+0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +10 +11 +12 +13	Remarks
1	1/11 155mm (T)		AE 3004 30 — AE 3000 24(a) — AE 3001 24(c)	
2	1/11 155mm (T)		AE 3004 30 — AE 3002 6 (b) — AE 3005 24 (c) — AE 3001 24 (c)	
				(a) DPICM
				(b)50% WP
				(c) VT

Fire Support Execution Matrix

The fire support execution matrix is a concise, easy planning and execution tool, which shows the many factors of a complicated fire support plan. This matrix may help the FSC and the commander understand how the fire plan supports the scheme of maneuver. It is a valuable planning tool for the offense and the defense. It explains the aspects of the support plan for which the FSC and each FO are responsible and the phase during the battle at which these aspects apply. When approved, the matrix becomes the primary execution tool. The matrix is set up with the maneuver elements shown along the left side and different phases (phase lines, events, or times) of the mission along the top. Phases used should correspond to phases established on maneuver execution matrixes. See page 99 for an example.

Company Level Matrix. At the company level, information to go in each box includes the following:

- Priorities of indirect fire support to a platoon, indicated by an abbreviation of that fire support asset, will appear in the upper left corner of the appropriate matrix box.

- The acronym FPF, preceded by the type of indirect fire means responsible for firing that FPF, will appear in the center of the box.

- Priority targets allocated to a platoon will appear in the box as PRI TGT, preceded by the means of fire support responsible for engaging the target followed by the target number.

- If an FO is responsible for the initiation of specific fires, the target number, group, or series designation will be listed in the box for that FO. Specific guidelines concerning fires not included on the target list worksheet will be included in that box.

- Each FSCM to be placed in effect, followed by a word designated for that measure, will be shown in the box. For ACAs, the time the planned CAS is due on station is listed.

- Other factors that apply to a certain platoon during a specific time frame may be included in the appropriate box. General guidance is issued in the written portion of the OPORD.

Battalion Level Matrix. At battalion level, the matrix is used as follows:

- If priority of any indirect fire support asset is allocated to a company, it is indicated by an abbreviation of that asset in the upper left corner of the appropriate matrix box.

- If an FPF has been allocated, the acronym FPF, preceded by the type of indirect fire means responsible for firing the that FPF, will appear in the center of the box.

- If a priority target is allocated to a company , it will appear in the box as PRI TGT, preceded by the means of fire support responsible for firing the target. Once a target is determined as the priority target, the corresponding target number is placed in the box.

- If a certain company FO is responsible for initiating specific fires, the target number, group, or series will be listed in the box for that FO. Specific guidelines concerning the fires not included on the target list worksheet will be included in the box.

- Each FSCM to be placed in effect, followed by a word designated for that measure, will be shown in the box. For ACAs, the time the planned CAS is due on station is listed.

- Other factors that apply to a certain company during a specific time frame may be included in the appropriate box. General guidance is issued in the written portion of the OPORD.

BATTALION FIRE SUPPORT EXECUTION MATRIX
(EXAMPLE)

	AA	LD	PL Chevy	PL Ford	PL Dodge
CO A	Mort FPF	Mort PRI TGT/AH2004	Mort PRI TGT/AH2006	Mort PRI TGT/AH2010		Mort FPF
	← Mort Priorty →				
CO B	155 FPF	← Sect AH1W/Detach Escort w/FAC(A) →		Sect F/A18/H+45 to H+75 FWCAS		155 FPF
TM MECH	155 FPF	Arty PRI TGT/AH2002 Sect AH1W/Detach Escort	Arty PRI TGT/AH2007	Arty GRP A1H		
	← Arty Priorty →				
TM TANK					Arty SERIES APPLE	155 FPF
					← Arty Priorty →	
81mm	FP #1		FP #2		FP #3	
BN FSC		Sect AV8B/H-15 to H+15 Prep BN OBJ 1	2 Sect AV8B/H+15 to H+45 Prep BN OBJ 1 & 2	CFL 2 & FSCL 2 in effect		

EXPLANATION: In this example, the Task Force has a main effort (TM Mech), two supporting attacks (COs A & B), and a reserve (TM Tank). On order, TM Tank becomes the ME and seizes Bn Obj 4. ***In the assembly area***, CO A has 81mm POF and an FPF. The BN has artillery POF and has been allocated two 155mm FPFs. CO B and TM Mech each have an artillery FPF, and TM Mech has artillery POF. TM Tank is in reserve. 81mm mortars are in firing position #1. ***From the AA to LD:*** CO A has mortar POF and a mortar priority target to cover the advance. CO B has a section of RW CAS in detached escort. TM Mech has artillery POF, an artillery priority target, and a section of RW CAS in detached escort. The Bn FSC maintains control of a section of AV-8B that will prep Bn Obj 1. ***From LD to PL Chevy:*** CO A maintains mortar POF and the priority target shifts. CO B maintains RW escort. TM Mech maintains artillery POF and priority target shifts. 81mm mortars occupy firing position #2 to continue support of CO A. BN FSC controls two sections AV-8B that will prepare Bn Obj 1 & 2. ***From PL Chevy to PL Ford (assault of Bn Obj 1 by ME, Bn Obj 2 by SPT #1, and Bn Obj 3 by SPT #2):*** CO A maintains mortar POF and priority target shifts. CO B maintains RW escort and adds section of F/A-18 for CAS controlled by RW FAC(A). TM Mech maintains artillery POF and has responsibility for firing artillery group A1H to prepare objective. BN FSC shifts CFL and FSCL. ***From PL Ford to PL Dodge (TM Tank becomes ME and seizes Bn Obj 4, TM Mech becomes reserve, COs A & B move to Bn Obj 4):*** CO A maintains mortar POF and priority target is canceled. CO B loses all air cover. Artillery POF shifts to TM Tank, which has responsibility for firing artillery series APPLE to prepare Bn Obj 4. 81mm mortars occupy firing position #3 to support CO A during consolidation. ***PL Dodge (consolidation on Bn Obj 4):*** CO A maintains mortar POF and FPF. CO B and TM Tank have 155 FPFs, with TM Tank having POF.

Call For Fire (CFF) Procedures

The CFF is a request for fire containing data necessary for obtaining the required fire on a target. It is a concise message prepared by the observer and transmitted as a request, not an order. It contains the information needed by the fire direction center (FDC) to determine the method of target attack. The call for fire is sent quickly, but clearly enough to be understood, recorded, and read back without error by the FDC recorder. Regardless of the method of target location used, the normal CFF is transmitted in three parts, consisting of six elements, with a break and read-back after each part. Below are the three transmissions and six elements.

1st transmission:

- Observer identification
- Warning order

2nd Transmission:

- Target location

3rd Transmission:

- Target description
- Method of engagement
- Method of fire and control

1st Transmission

Observer Identification. This element of the CFF tells the FDC who is calling for fire. The observer uses a call sign.

Warning Order. The warning order clears the net for the fire mission and tells the FDC the type of mission and the type of target location that will be used. The warning order consists of the type of mission, the size of the element to fire for effect, and the method of target location. It is a request for fire unless prior authority has been given to order fire.

Type of Mission.

- **Adjust Fire (AF).** When the observer believes that adjustment must be made he announces **ADJUST FIRE**.

- **Fire for Effect (FFE).** The observer should always strive for first round FFE. The accuracy required to FFE depends on the accuracy of target location and the ammunition being used. When the observer is certain the target location is accurate and that the first volley should have the desired effect on the target so that little or no adjustment is required, he announces **FIRE FOR EFFECT.**

- **Suppression.** To quickly bring fire on a target that is not active, the observer announces **SUPPRESS** (followed by the target location). Suppression missions are normally fired on preplanned targets, and a duration is associated with the CFF.

- **Immediate Suppression and Immediate SMOKE.** When engaging a planned target or target of opportunity that has taken friendly maneuver or aerial elements under fire, the observer announces **IMMEDIATE SUPPRESSION** or **IMMEDIATE SMOKE** (followed by the target location). Though the grid method of target location is the most common, any method of target location can be used.

Size of Element to FFE. Generally, the observer will not request a specific size unit to FFE; therefore, the battalion FDC makes the decision.

Method of Target Location.

- **Polar Plot.** If the target is located by the polar plot method of target location, the observer announces **POLAR**.

- **Shift From Known Point (Target #).** If the target is located by the shift from known point method of target location, the observer announces **SHIFT** (followed by the known point # or the target **#).**

- **Grid.** If the grid method of target location is used, the word *grid* is not announced.

EXAMPLES OF 1st TRANSMISSION:

NOTE: "de" is shorthand for "this is" and the subscript "k" is shorthand for "over."

Adjust Fire Mission:
Grid Method - A57 de A71, AF_k

Fire for Effect Mission:
Polar Plot Method - A57 de A71, FFE, $Polar_k$
Shift From Target Method - A57 de A71, FFE, Shift $AC2204_k$

Suppression Mission:
F28 de F72, Suppress $AC4573_k$

Immediate Suppression Mission:
F28 de F72, Immediate Suppression, Grid 453215_k

2nd Transmission

Target Location. This allows the FDC to plot the location of the target to determine firing data.

- **Grid Method.** In a grid mission, six-place grids are normally sent. Eight place grids should be sent only when greater accuracy is needed. The observer-target (OT) direction normally will be sent after the entire initial CFF, since it is not needed by the FDC to locate the target.

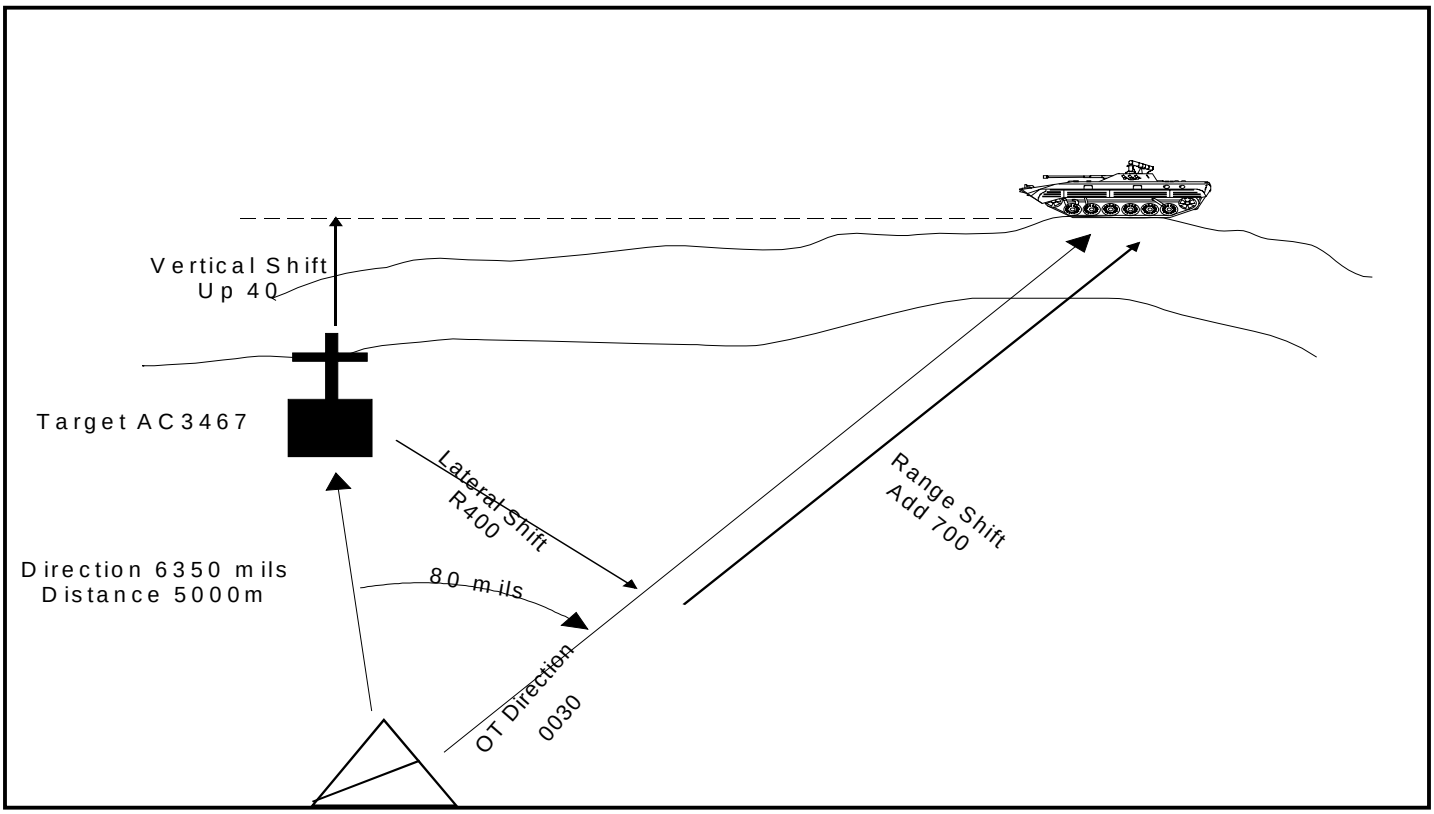
- **Polar Plot Method.** In a polar mission, the word *polar* in the warning order alerts the FDC that the target will be located with respect to the observer's position. The observer's location must be known in the FDC. The observer then sends OT direction and distance. A vertical shift is only sent if it exceeds 30m.

- **Shift From Known Point (Target #).** In this mission, the point or target from which the shift will be made is sent in the warning order. The point must be known to both the observer and the FDC. The observer then sends the OT direction. Normally, it is sent in mils; however, the FDC can accept degrees or cardinal directions. The corrections are sent next (see figure on next page):

  - The lateral shift (how far left or right the target is) from the known point (to the nearest 10m).

  - The range shift (how much farther [ADD] or closer [DROP] the target is in relation to the known point (to the nearest 100m).

  - The vertical shift (how much the target is above [UP] or below [DOWN] the altitude of the known point, to the nearest 5m). The vertical shift is ignored unless it exceeds 30m.



Determination of Lateral Shift:

W = R x M (mil relation)

W = width of lateral shift in meters

R = distance to the known point divided by 1000, expressed to the nearest 0.1

M = measured angle in mils between the known point and the target

In the above example: W = (5000 ÷ 1000) x 80 = 400m

Determination of Range and Vertical Shift: The FO estimates these to the best of his ability.

<u>EXAMPLES OF 1st AND 2nd TRANSMISSIONS</u>:

Adjust Fire:

A57 de A71, AF_k

Grid 479632_k

Fire for Effect:

A57 de A71, FFE, $Polar_k$

Dir 1670, Dist 4200_k

A57 de A71, FFE, Shift $AC2204_k$

Dir NW, L400, Drop 300, Up 50_k

3rd Transmission

Target Description. The observer must describe the target in enough detail that the FDC can determine the amount and type of ammunition to use. The FDC selects different ammunition for different types of targets. The observer should be brief, but accurate. The description should contain the following:

- What the target is (troops, equipment, vehicles, etc.).
- What the target is doing (digging in, in an assembly area, etc.).
- The number of elements in the target (squad, platoon, six tanks, etc.).
- The degree of protection (in open, in bunkers with overhead cover, etc.).
- The target size and shape if these are significant.
  Rectangular - length, width, and attitude
  Linear - length and attitude
  Circular - radius

Method of Engagement. The observer may indicate how he wants to attack the target. This element consists of the type of adjustment, trajectory, ammunition, and distribution. Danger close and "mark" are included as necessary.

- **Type of Adjustment.** Two types may be employed: precision and area. Precision adjustment is used for registrations and destruction missions. These are used only in special situations; therefore, unless specified, area adjustment is used.
- **Danger Close.** This is included when rounds will impact within 600m of friendly troops for mortar and artillery fire and 750m for NGF.
- **Mark.** This is included to indicate that the observer is going to call for rounds for either marking center of the sector or for marking targets for aircraft.
- **Trajectory.** Low angle fire is standard for artillery. If high angle is requested by the FO or the FDC determines it is necessary to engage the target, it will be fired. Mortars only fire high angle.
- **Ammunition.** The FO may request any type of ammunition during the adjustment or FFE phase of the mission. Shell HE with fuze quick is normally used during adjustment. The target description helps the FDC determine the ammunition to fire if the FO does not request a specific type.
- **Distribution.** The observer may control the pattern of bursts in the target area. This pattern is called a sheaf. Unless specified, the FDC computes a standard, circular sheaf. This sheaf will cover a circular target that has a 100m radius.

Method of Fire and Control. The method of fire and control element indicates the desired manner of attacking the target, whether the observer wants to control the time of delivery of fire, and whether he can observe the target. Methods of control at my command (AMC) and time on target (TOT) are especially useful in massing fires. The AMC and TOT missions achieve surprise and maximize the effects of the initial volley on a target. When used by the observer, these methods of control can reduce the sporadic engagement of the target, or "popcorn effect," which can be the effect of rounds that are fired "when ready." Other methods of fire and control are found in MCWP 3-16-6 Supporting Arms Observer, Spotter and Controller.

EXAMPLES OF COMPLETE CFF:

NOTE: I/O = in open, I/E = in effect

Adjust Fire:

A57 de A71, AF_k
Grid 479632_k
BMP Plt w/Dism Inf I/O, ICM I/E_k

Fire for Effect:

A57 de A71, FFE $Polar_k$
Dir 1770, Dist 4200_k
Moving Supply Convoy on Road, Length 300, Attitude 2100, HE/WP, AMC_k

A57 de A71, FFE, Shift $AC2204_k$
Dir NW, L400, Drop 300, Up 50_k
Bn Assembly Area, Radius 200, VT, TOT 1015_k

Adjust Fire Corrections. After a spotting has been made, the observer must send corrections to the FDC to move the burst onto the adjusting point. The corrections are sent in meters. The order transmitted is: deviation (left or right), range (add or drop), and height of burst (up or down) for time fuzes.

Deviation Correction. The distance in meters that the burst is to be moved (right or left) is determined by multiplying the observer's deviation spotting in mils by the OT distance in thousands of meters (OT factor). Deviation corrections are expressed to the nearest 10m. A deviation correction less than 30m is a minor correction and is disregarded except as refinement data or in a destruction mission.

To determine the OT factor when the OT distance is greater than 1000m, the distance is expressed to the nearest 1000, and then expressed in thousands.

Example: OT distance = 4200 (expresses to 4000)
OT factor (expressed in thousands) = 4

For an OT distance less than 1000m, the distance is expressed to the nearest 100m, and expressed in thousands.

Example: OT distance = 800
OT factor = 0.8

The computed deviation correction is announced to the FDC as **LEFT** or **RIGHT** (so much). The correction is opposite the spotting.

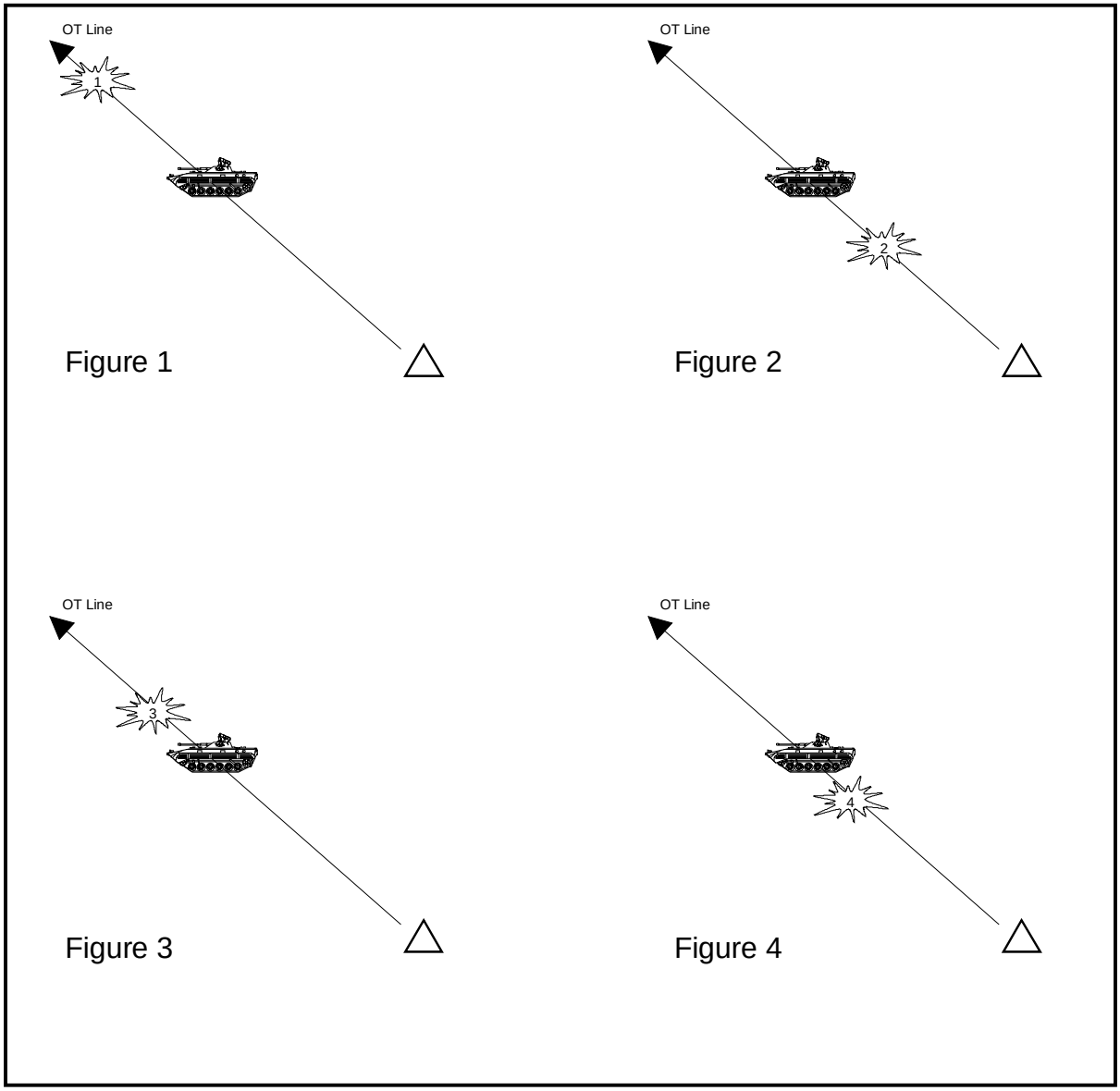
Determination of Deviation Corrections

OT Distance (m)	OT Factor	Spotting	Deviation Correction
4000	4	45R	LEFT 180
2400	2	100L	RIGHT 200
3400	3	55L	RIGHT 160
1600	2	20R	LEFT 40
700	0.7	45L	RIGHT 30

Range Corrections. When making a range correction, the observer attempts to add or drop the adjusting round, along the OT line, from the previous burst to the target. If his spotting was short, he will add. If his spotting was over, he will drop. The observer must be aggressive in the adjustment phase of an adjust fire mission. He must use every opportunity to shorten that phase. He should make every effort to correct the initial round onto the target and enter FFE as soon as possible. Successive bracketing procedures should be used only when time is not critical.

When conducting an adjustment onto a target, the observer may choose to establish a range bracket. Successive bracketing will guarantee rounds within 50m of the target when finished. After the first definite range spotting is determined, the observer should send a range correction to the FDC to establish a range bracket of known distance (one round over and one round short). Once the bracket has been established, the observer successively splits the bracket until he is assured the rounds will be within 50m of the adjusting point when he enters FFE. Normally, range changes 50, 100, 200, 400, or 800 are used to make splitting the bracket easier.

Example: The first round impacts over the adjusting point (see Figure 1). The observer should drop enough to place the next round short of the adjusting point. The observer sent **DROP 400** after observing his first round. The next round impacted short of the adjusting point (see Figure 2). The observer has now established a range bracket. He has had one round over and one round short of the adjusting point, separated by 400m. Using successive bracketing, the observer sends **ADD 200**. The third round impacts over the adjusting point (see Figure 3). The observer has a 200m bracket because round #2 impacted short of the adjusting point and the distance between the rounds was 200m. Splitting the bracket, the observer sends **DROP 100**. The fourth round impacts short (see Figure 4). The observer has a 100m bracket. He now sends **ADD 50, FFE**. The center of impact of the FFE rounds is now mathematically certain of being within 50m of the adjusting point.



Height of Burst (HOB) Corrections. One gun is used when adjusting fuze time. The observer adjusts the HOB after splitting the 100m bracket with fuze quick to obtain a 20m HOB for fuze time in FFE. For example: **DROP 50, FUZE TIME$_{\mathbf{K}}$**. Once the first time fuze is fired, the observer will announce a correction of **UP** or **DOWN** (so many meters) to correct to a 20m HOB.

If the spotting of the initial round is a graze burst, an automatic correction of **UP 40** is sent. If the round is an airburst, the HOB of the round is computed (HOB spotting in mils above the adjusting point multiplied by the OT factor). The appropriate HOB correction is given to the nearest 5m to obtain the desired 20m HOB. For example, an airburst is measured with a HOB = 4 mils. The OT factor = 3. Therefore, the HOB = 12m. The burst needs to be raised 8m, so it is expressed to 10m (nearest 5). **UP 10, FFE** would be sent to the FDC.

Naval Gunfire (NGF) Call for Fire (CFF)

Elements of the CFF. The NGF spotter must communicate effectively with the ship to perform his primary duty of providing NGF. The spotter achieves this by employing a standard CFF. The CFF is transmitted to the ship in two transmissions, consisting of six elements, with a read-back after each transmission. The sequence of the two transmissions is as follows:

- Spotter identification, warning order, and target number.

- Target location, target description, method of engagement, and method of control.

1st Transmission

Spotter Identification. The spotter identification (call sign) tells the ship who is calling for fire.

Warning Order. The warning order informs the ship that a CFF is being transmitted. It clears the net and warns the ship that firing on a target is desired. The warning order consists of the words "Fire Mission."

Target Number. The spotter assigns a target number to each target he calls for fire on. By use of a target number, the ship and the NGLO monitoring the mission are able to track each location being fired on. For targets of opportunity, the spotter assigns each fire mission a number from the block allocated by the FSCC, or the FSCC may assign the target number. In the case of planned targets, the spotter uses his assigned target number block.

EXAMPLE OF 1st TRANSMISSION:

A18 de C25, Fire Mission, Target $AB2135_k$

2nd Transmission

Target Location. Target location provides the ship with the information needed to plot the target and determine firing data.

Grid. The spotter announces "**GRID**" followed by the coordinates of the target, "**ALTITUDE**" followed by the altitude of the target which is measured from mean sea level, and "**DIRECTION**" followed by the spotting line only if the method of control is spotter adjust.

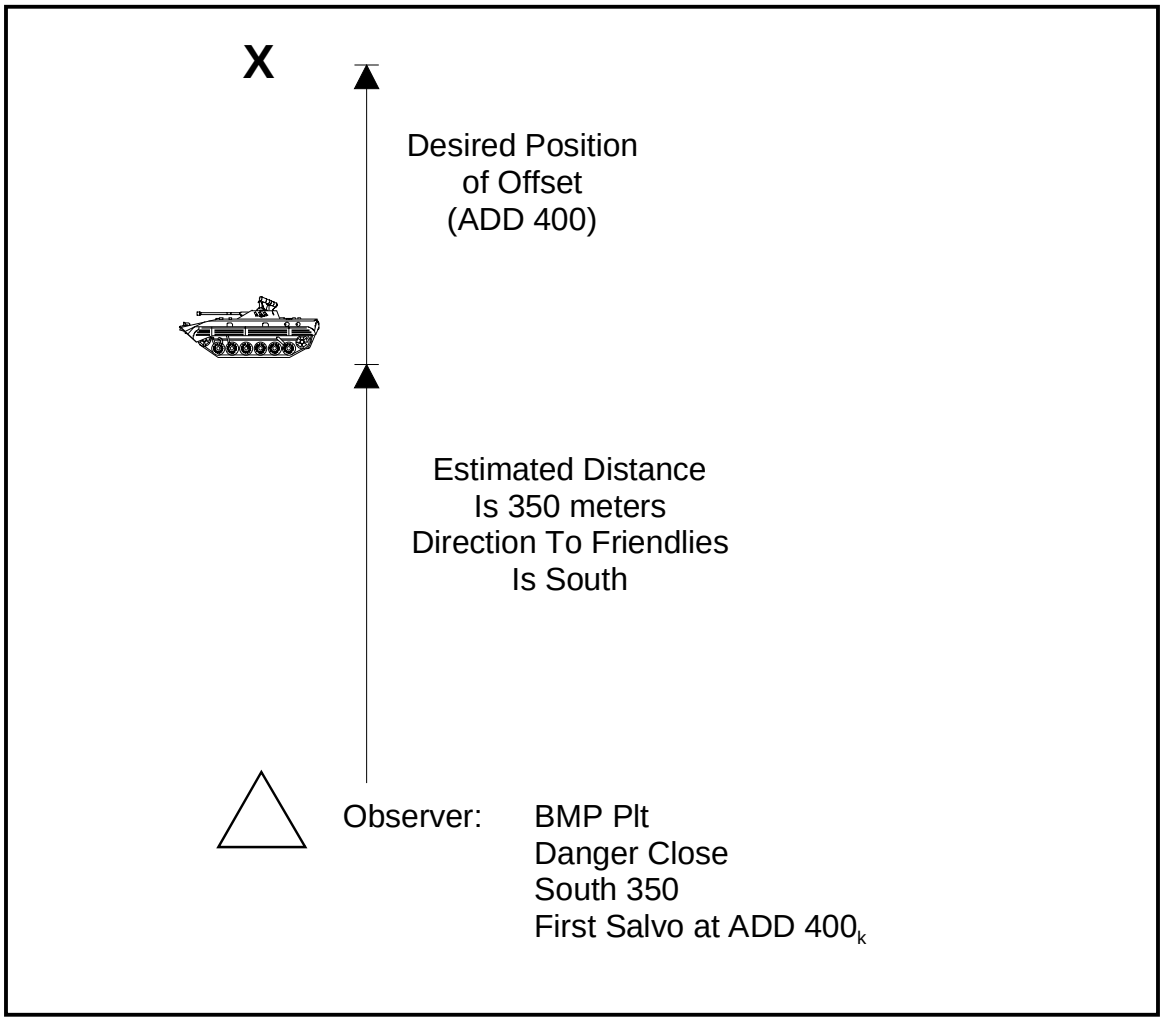
Polar. The spotter announces "**DIRECTION**" followed by the spotting line (i.e., 1680 mils), "**DISTANCE**" followed by the distance from the spotter to the target in meters, and an "**UP**" or "**DOWN**" vertical shift.

Shift From Known Point (Target #). The spotter announces "**FROM REFERENCE POINT**" (or target number), "**DIRECTION**" followed by the spotting line, the lateral shift as "**LEFT**" or "**RIGHT,**" the range shift as "**ADD**" or "**DROP,**" and "**UP**" or "**DOWN**" vertical shift.

Target Description. Target description gives a brief description of the target. The spotter considers the type of target, size, and degree of protection when formulating target description.

Method of Engagement. Method of engagement is the element that the spotter uses to describe the attack of the target. The subelements of the method of engagement include danger close, trajectory, ammunition, number of guns, number of salvos, and special instructions. Some of the subelements are standard and will be provided automatically unless the spotter specifies otherwise. The standard method of engagement for trajectory uses a full charge, which produces a high muzzle velocity and a flat trajectory. The standard method of engagement for ammunition is HE/Q, for number of guns is one, and for number of salvos is one.

Danger Close. The term danger close is included in the method of engagement when there are friendly troops or positions within 750m of the target. The spotter reports "**DANGER CLOSE**" followed by the cardinal direction and distance from the target to the nearest friendly position. The spotter also designates the place where the first salvo (round) is to impact. The first salvo can either be **OFFSET** or **DIRECTED AT TARGET**.
The first salvo may be offset to impact on the side of the target opposite the location of the friendly position. This is done by a normal correction made in relation to the spotting direction (left/right and add/drop) or as a cardinal direction and a distance. The offset between the nearest friendly position and the first salvo can be any distance specified by the spotter, but is normally at least 750m total.



Trajectory. This subelement applies to ships capable of firing reduced charge or high angle. The normal trajectory is flat and fired full charge propellant. This is standard. The spotter may specify a nonstandard trajectory when required. The nonstandard trajectories are **REDUCED CHARGE** and **HIGH ANGLE**.

Ammunition. There are several types of ammunition available to the spotter. The standard type of ammunition is shell HE with fuze Q. If no ammunition is specified in the CFF, HE/Q will be fired in the adjustment and FFE phases. As much warning as possible should be provided to the ship when a mission requires a nonstandard projectile and fuze. This allows time to ready the ammunition in the gun mount. The quantities of nonstandard ammunition carried in the ship's magazine are limited.

Number of Guns. The spotter may specify the number guns to be used in adjustment and in FFE. If the number of guns for effect is not specified, it is understood to be the same number as used in adjustment. If more than one gun is desired, the number of guns must be specified.

Number of Salvos. The term salvo indicates the number of rounds fired from each gun. For example: 1 gun, 5 salvos is 5 rounds; 2 guns, 5 salvos is 10 rounds.

Special Instructions. The spotter uses special instructions in the CFF when he desires the use of specific, nonstandard techniques to attack a target. Some special instructions are interval, sustained fire, time on target, coordinated illumination, and continuous illumination.

Method of Control. Method of control indicates the spotter's desire or ability to control the delivery of fire. The standard method of control is "**SPOTTER ADJUST**" and is omitted in the CFF. The nonstandard methods of control are "**FFE**" and "**SHIP ADJUST**." All methods of control can be modified by the command "**AT MY COMMAND**."

EXAMPLES OF COMPLETE NGF CFF:

Grid Method, Spotter Adjust:

A18 de C25, Fire Mission, Target AB2135$_k$
Grid 786543, Altitude 30, Dir 2680, 50 troops I/O, Fuze CVT I/E$_k$

Polar Plot Method, At My Command:

A18 de C25, Fire Mission, Target AB2135$_k$
Direction 4880, Dist 2900, Up 35, 3 Trucks Refueling I/O, WP I/E, AMC$_k$

Shift Known Point, FFE:

A18 de C25, Fire Mission, Target AB2135$_k$
From Target AB 3772, Dir 3470, L280, +500, Supply Depot in Defilade, Radius 200, Reduced Charge, 2 Guns, 10 Salvos, FFE$_k$

Adjustment of NGF. The procedures for adjusting NGF are the same as for artillery and mortars. However, the observer must pay close attention the relationship between the OT line and the gun-target (GT) line. NGF has a GT line that continually changes and will generate a "ping-pong" effect of the rounds when adjusting.

Ammunition Selection Criteria

Once the observer has decided to attack a target, he must select a weapon-ammunition combination that can achieve the desired effect with a minimum expenditure of available ammunition stocks. To do this, the observer must know the characteristics, capabilities, and vulnerabilities of all fire support assets.

Ammunition Type and Quantity. The nature of the target and its surroundings and the desired effects dictate the type and amount of ammunition to be used. Some types of fires require greater ammunition expenditures than others. Suppression and neutralization fires usually consume less ammunition than destruction fires.

Troop Safety. Troop safety is a major concern when considering the weapon and ammunition selection for firing close-in targets. The observer ensures that fires and their effects do not endanger friendly troops, equipment, and facilities.

Residual Effects in the Target Area. Residual effects from special munitions influence the occupation of an area. For example, use of FASCAM may change the direction of movement of supported elements. If supported troops are to occupy an area immediately following an attack by certain munitions, conditions may be hazardous.

Effectiveness. When properly delivered against appropriate targets, air, artillery, mortar, and NGF can be the decisive factors in a battle. The observer must ensure that maximum effectiveness is attained from every mission. The lethality of a munition must be matched to the specific vulnerability of the target. Therefore, the observer must understand the damage potential of blast, cratering, fragmentation, incendiary, and penetration effects from specific munitions.

Artillery, Mortar, and NGF Munitions

Munition (Common Name)	Weapon/Range	Fuzes	Suitable For
High Explosive (HE)	81mm/4.8km 155mm/18.1km NGF/21.8km	Point Detonating (PD) or Quick (Q)	-Adjust fire -Personnel in open -Light armored vehicles
		Delay (DEL)-0.05 sec	-Targets in trees -Bunkers -Earth and log emplacements -Hard targets -Adjusting FPF
		Variable Time (VT) always 7m HOB-no adjustment necessary	-Personnel in open -Personnel in trenches -Light armored vehicles
		Mechanical Time (MT) 81mm & 155mm Controlled Variable Time (CVT) NGF MT & CVT require HOB adjust	Same as VT
White Phosphorous (WP)	81mm/4.8km 155mm/18.1km NGF/21.8km	PD & MT only	-Incendiary -Marking -Screening -Obscuring -Vehicles -POL/ammo
Red Phosphorous (RP)	81mm/4.8km	MT only	-Screening -Obscuring
Illumination (Illum)	81mm/3.1km 155mm/18.1km NGF/21.8km	MT only	-Harassment -Marking -81mm: 800m diameter for 1 min -155mm: 1000m diameter for 2 min
Rocket Assisted Projectile (RAP)	155mm/30.1km NGF/29.1km	155mm-PD & MT only NGF-PD & CVT only	-Same as HE when increased range required
Dual Purpose Improved Conventional Munitions (DPICM)	155mm/17.7km	MT only	-Each round contains 88 submunitions -2% dud rate -Penetrate 2.75" of steel -Personnel in open (frag) -Light armored vehicles (penetration)
Extended Range DPICM (ERDPICM)	155mm/28.1km	MT only	-Same as DPICM except only 72 submunitions -War stocks only
Family of Scatterable Mines (FASCAM)	155mm/17.7km	MT only	ADAM-Area Denial Artillery Munition (antipersonnel) RAAM-Remote Antiarmor Munition
Copperhead	155mm/16km	N/A	-Laser guided -High payoff point targets
M825 Improved WP Smoke (M825)	155mm/17.7km	MT only	-Screening -Obscuring

Environmental and Terrain Considerations for Fire Support

Mountain Operations. IPB helps determine where and what munitions are most effective. Consideration of munitions employment and effect are as follows:

Snow

- FASCAM may settle into snow which may cause the anti-handling devices to prematurely detonate the munitions.
- Mechanical time fuses are most effective.
- HE/Q, HE/DEL, and DPICM are ineffective because a large percentage of the effects are muted by the snow.
- WP can burn undetected in snow for up to 4 days.
- Smoke effectiveness reduced.
- Illumination burns into snow and becomes, effectively buried.

Rocky Terrain

- HE/Q is very effective because it produces fragmentation from splintering rocks.
- VT and MT fuzes are effective, particularly on reverse slopes and in ravines and waddies.
- DPICM is effective, but it can hang up in forested areas.
- FASCAM can be used to deny the enemy the use of narrow defiles, valleys, roads, and usable terrain.
- Copperhead is effective.
- Swirling winds and slopes make smoke employment difficult.
- Close coordination is required with adjacent units to avoid obscuring their vision with drifting smoke or illuminating them.
- Mortars can deliver high angle fires on reverse slopes and intermediate crests.
- Rugged terrain reduces vulnerability of target, thus increases required volume of fires to achieve effects.

- High angle fires result in less range and accuracy.
- Changing atmospheric conditions make unobserved fires less accurate.
- Rock slides can be started.
- CAS can attack reverse slope targets. Steep slopes may restrict aircraft ingress/egress routes.

Jungle Operations. Most contact with the enemy will be at extremely close ranges. Knowledge of the type of munitions best suited for the terrain and how to employ them is vital.

- HE/DEL will penetrate the treetops and splinter the trees creating additional fragmentation.
- Smoke has limited effectiveness.
- WP is effective as a marking round and in initial adjustments.

Desert Operations

Mountain and Rocky Plateau Deserts. Munitions effectiveness for mountain deserts is the same as for any mountainous region, except that the considerations for snow are not applicable.

Sandy or Dune Deserts

- HE/Q, HE/DEL, DPICM, and FASCAM are smothered by deep sands, making them effective.
- VT and MT fuzes are very effective.
- Copperhead is very effective.
- Smoke and illumination are effective and can be used to silhouette the enemy.

Cold Weather Operations

- Make maximum use of air burst munitions.
- HE/Q, HE/DEL, DPICM, and FASCAM are ineffective in deep snow.
- WP is effective; however, it may burn for extended periods undetected, which presents a hazard to friendly troops maneuvering in the area.
- Extreme cold weather reduces the range of weapons.

Military Operations on Urbanized Terrain (MOUT)

- Effectiveness of DPICM and HE/VT is reduced by structures, although these munitions are effective against personnel on rooftops.
- High angle fire with DEL fuzing is required to penetrate buildings.
- Illumination and WP are especially effective.
- Smoke can be used to screen movements and obscure enemy obscuration.
- Ammunition expenditures will be heavy.

Employment Considerations for the AH-1W

Minumum Safe Distances

Weapon	Under Cover	Standing
20mm Cannon	25m	175m
TOW	25m	50m
Hellfire	25m	50m
2.75" Rocket	100m	275m
5.0" Rocket	200m	600m

Ordnance Knowledge

- Capable of carrying 750 rounds of 20mm.
- Fires 650 rounds a minute.
- 2.75" rockets come in 7-shot and 19-shot pods.
- 5.0" rockets come in 4-shot pods.
- There are four wing stations, two inside and two outside, that enable the Cobra to carry many different ordnance loads.
- Hellfire, TOW, and Sidewinder launchers are limited to the two outside stations.
- Can carry up to four Hellfire or TOW on either outside station.
- Carries 60 aircraft expendable decoy flares/chaff bundles.
- Can carry the AIM-9 air-to-air missile (maximum of two).
- Can carry the Sidearm anti-radiation missile (maximum of two).
- 77-gallon auxiliary fuel tank can replace any of the four wing stations.

Aircraft Knowledge

- Maximum speed of 190 knots in a dive.
- 130-150 fully loaded.
- Time on station from take-off to landing is generally 1 + 45.
- Can carry approximately 1700-2000 lbs of ordnance depending on fuel required.

Night Operations

- All weapons can be operated at night. This capability is extremely enhanced by the introduction of the Night Targeting System (NTS) aircraft. The NTS brings autonomous laser operations, FLIR, and laser range-finding to the battlefield.

HELICOPTER DELIVERED ORDNANCE
AH-1W

Munition (Common Name)	Type/Range	Fuzes	Suitable For
HE Frag	2.75" and 5" Rockets/2500/3000	Impact, Proximity, VT	-Area targets -Personnel in the open -Light skinned vehicles -Suppression
Flechette (2200 small darts)	2.75" Rocket/1200-1500m	Time, Motor Burnout	-Personnel -Thin-skinned vehicles
High Explosive Antitank (HEAT)	2.75" Rocket/2500m	Impact	-Tanks (last resort) -Bunkers -Armored vehicles
Illumination	2.75" Rocket/3500m	Time	-Illumination -1,000,000 candlepower for 100 seconds (per rocket) -Marking
Smoke (White Phosphorous/Red Phosphorous)	2.25" and 5"/Rockets 2500/3000	Impact	-Marking -POL/Fuel ignition
HE GP	5" Rocket/3000m	Impact	-Concrete bunkers -Surface vessels -Buildings -Personnel
AT/APERS	5" Rocket/3000m	Impact, Proximity	-Heavily armored targets -Light armored targets -Personnel
Chaff/Countermeasures	5" Rocket/3000m	Time	-Chaff deployment along flight corridors (radar threat)
LUU-2B Parachute Flare	Flare Dispenser/Drops straight down from aircraft	Time	-Illumination -2,000,000 candlepower for 240 seconds (per flare) -8 flares per dispenser

AH-1W PRECISION GUIDED MUNITIONS

Munition	Mode Min/Max Range	Time of Flight (70 Deg F)	Suitable For
AGM-114B Hellfire -Guided on reflected laser energy -Four modes Lock on before launch (LOBL) Lock on after launch (LOAL) LO/HI/Direct	LOBL 750m/7000m LOAL LO 2000m/8000m LOAL HI 3500/8000m LOAL DIR 1720/7000	Range(km) Time(sec) 1 3 2 6 3 10 4 14 5 18 6 23 7 29 8 37	-Armor/all types -High value targets -Bunkers -Rotary wing aircraft -Fixed-wing aircraft -Command and control *Can defeat any current threat vehicle
BGM-71C TOW	Wire Guided 500/3750	21.5 seconds	-Armor -Bunkers -Point targets -Slow moving aircraft -Vehicles
AIM-9 Sidewinder	IR	TBD	-All aircraft
AGM-122A Sidearm	Antiradiation TBD	TBD	Radar emitting threat

AH-1W 20MM CANNON

Munition	Range	Suitable For
M56 High Explosive -Incendiary /Tracer	2000m	-Aircraft -Light material targets -Personnel
PGU-28/B Semiarmor-piercing High Explosive Incendiary (SAPHEI)	2000m	-Aircraft -Light armor -Personnel
Target Practice	2000m	-Training -Light armor

Environmental and Terrain Considerations for Cobra RWCAS

Mountain Operations. The Cobra is well-suited for operating in a mountain environment.

Considerations

- Comm will be difficult.
- Visually acquiring the aircraft will be difficult.

Snow

- TOW and Hellfire will be effective.
- Laser energy may reflect off snow and ice.
- WP/RP effects will be reduced.
- Effects of HE rockets will be reduced by the snow.

Rocky Terrain

- All ordnance should be effective against targets in rocky terrain.
- Dug-in troops will be hard to defeat with area weapons.
- HE ordnance effects will be enhanced by fragmented rocks.
- Enemy can hide easily in the mountains.
- Launch Hellfire from behind masked terrain.

Jungle Operations. Extremely difficult to identify targets in forested terrain. Close coordination between FAC and aircraft is required.

Considerations

- Hellfire missiles may not be able to pick up laser energy.
- TOW missile engagement will be much harder in a covered area. Engagement window may be extremely small.
- 20mm will be effective.
- Rockets will be effective if target can be positively identified from the air; i.e., good mark.

Desert Operations

Considerations

- Weapons can usually be used at their maximum range.
- Blowing sand from rotor wash can give position of aircraft away.
- Ability to ID targets from long distances.
- Hard to hide from threat weapons.
- Heat may cause FLIR to become useless during the transitional times of the day.

MOUT. Night helicopter operations in the city can be severely degraded by the light given off from city buildings.

Considerations

- Laser energy can reflect off many different things than the intended target.
- TOW operation over power lines may result in loss of the missile from wire break.
- May be hard to line TOW launch up with the threat due to obstacles.
- Effects of rockets and 20mm may be limited due to ROE.
- ROE permitting rocket and 20mm fire may be enhanced due to close quarters.
- Pilots may have to remove NVGs.

Employment Considerations for the AV-8B

Ordnance

Air-to-Ground Weapons
25mm Cannon Gun Pod - 300 rounds
Cluster Bombs - Rockeye (antipersonnel, antitank), Gator (air deliverable minefield), APAM (antipersonnel, antimaterial)
MK-82, 83 General Purpose Bombs, low or high drag (500, 1,000 lb)
GBU-12, 16 (laser guided variants of MK-80 series bombs, low drag only)
2.75" & 5" Rockets (primarily used for FAC(A) missions)
AGM-65 Maverick (laser guided antitank missile)
Napalm
LUU-2 Parachute Flares

Air-to-Air Weapons
25mm Cannon Gun Pod
AIM-9 Sidewinder (IR missile)

Special Purpose Equipment
APG-65 Radar (same radar as F/A-18, found only on Harrier II Plus, increases weapons delivery accuracy)
NAVFLIR (Navigation Forward Looking Infra-Red, used for nighttime navigation, night attack and radar variants only)
LST (Laser Spot Tracker, detects laser energy directed on target from external source (FAC), not available on radar variant)
NVG (Night Vision Goggles, aid pilot in navigation/target identification at night)

Ordnance Loads and Profiles

- Total ordnance capacity - 8,000 lbs
- Six Rockeye or six 500-lb GP bombs will be normal ordnance load with two AIM-9 missiles.
- If aircraft requires vertical takeoff (LHA/LHD), ordnance loads are reduced.
- High drag bombs and napalm require low altitude deliveries exposing aircraft to AAA and small arms fire.
- Low drag bombs require medium or high altitude delivery, and low cloud ceilings or low visibility restrict their use.
- General purpose bombs have multiple fusing options (mechanical contact fuses, electrical fuses with variable time delays).

Aircraft Knowledge

- Maximum speed is .98 mach at high altitude, 550 knots at sea level.
- Normal ordnance delivery speed is 420-480 knots.
- Time on station after 30-minute transit: 20-40 minutes.
- Combat radius is approximately 280 miles.

Employment Considerations for the F/A-18

Ordnance

Air-to-Ground Weapons
20mm Cannon - 578 rounds
Cluster Bombs - Rockeye (antipersonnel, antitank), Gator (air deliverable minefield), APAM (antipersonnel, antimaterial); dispersion pattern roughly football field in size, dependent on release altitude)
MK-82, 83, 84 General Purpose Bombs, low or high drag (500, 1,000, 2,000 lb)
- Frag radius of 500-lb bomb is 2800 ft, 1,000 and 2,000-lb is 3,000 ft)

GBU-12, 16, 10 (laser guided variants of MK-80 series bombs, low drag only)
MK-36, 40, 41, 52, 55, 56 Series Mines
2.75" & 5" Rockets (primarily used for FAC(A) missions with WP rounds)
AGM-65E/F Maverick (laser or IR guided antitank missile, range 14+ miles)
AGM-88 HARM (anti-radar missile, destroys emitting radar antenna dishes)
AGM-84C/D Harpoon (anti-ship missile)
AGM-84E SLAM (land attack variant of Harpoon)
AGM-62 Walleye (Glide Bomb, range 15+ miles, dependent on release altitude)
Napalm
LUU-2 Parachute Flares (used for night bombing)
JSOW (Joint Standoff Weapon)
JDAM (Joint Direct Attack Munition)

Air-to-Air Weapons
20mm Cannon
AIM-9 Sidewinder (IR missile)
AIM-7 Sparrow (semi-active radar missile, requires aircraft radar to track target during time-out)
AIM-120 AMRAAM (active radar missile, can self-track target after launch)

Special Purpose Pods
NAVFLIR (Navigation Forward Looking Infra-Red, used for nighttime navigation)
Laser FLIR (Forward Looking Infra-Red, slewable to track and laser designate targets)
LST/SCAM (Laser Spot Tracker/Strike Camera, front half of pod detects laser energy from external source (FAC), and rear of pod has 35mm camera that photographs target before, during, and after weapons impact)
NVGs (night vision goggles, aid pilot in navigation/taraget identification at night)

Ordnance Loads and Profiles

- Total ordnance capacity is 13,700 lbs on 9 stations
  - The two wingtip stations hold only AIM-9 missiles.
  - The two side fuselage stations hold either AIM-7, AIM-120, FLIR, or LST pods.
  - Remaining five stations carry either air-to-air or air-to-ground weapons, or fuel tanks.
  - Two to four 1,000-lb bombs will be normal air-to-ground ordnance with either one or two external fuel tanks

- High drag bombs and napalm require low altitude deliveries exposing aircraft to AAA and small airs fire.
- Low drag bombs require medium or high altitude delivery, and low cloud ceilings or low visibility could restrict their use.
- General purpose bombs have multiple fusing options (mechanical contact fuses, electrical fuses with variable time delays)
- Laser guided weapons require good visibility from release point, and from designator (airborne or ground)
- Laser guided weapons should not be employed too close in proximity or time to one another to reduce chances of battlefield obscuration.

Aircraft Knowledge

- Maximum speed is 1.8 mach at high altitude, 550 knots at sea level.
- Normal ordnance delivery speed is 480-540 knots.
- Time on station after 30-minute transit - 30-45 minutes.
- Combat radius is 450 miles with high altitude profile.

Aircraft Capabilities Chart

Type	Crew	Performance	Payload	Sensors/ Self-protection	Comm/ Navigation
F/A-18 A/C F/A-18D	1 2	Maximum level speed @ sea level: 550 kias Typical delivery speed: 500 kias Maximum endurance speed: 250 kias Time on station after 30-min transit: 30-45 min Radius of action: LLL 150 nmi HLH 360 nmi HHH 450 nmi	13,700 lbs Air-to-air: Sparrow, Sidewinder, AMRAAM, 20mm gun Air-to-ground: MK-80 Series/LGBs, 2.75"/5" rockets, MK-20, CBU-59/78, MK-77, Maverick, HARM, MK-50/60 Series, Walleye I/III JSOW/JDAM Tactical air-launched decoy	Radar NAVFLIR Targeting FLIR[1] NVG[1] HARM Seeker Head Strike Camera LST Laser (Self) Designator ALR-67 ALQ-126 Flares/Chaff	2 UHF (AM/FM) 2 VHF (AM/FM) TADIL-C Secure voice Radio relay TACAN Automatic direction finder Inertial navigation system Radar NAVFLIR
AV-8B	1	Maximum level speed @ sea level: 500 kias Typical delivery speed: 500 kias Maximum endurance speed: 230 kias Time on station after 30-min transit: 20-40 min Radius of action: LLL 140 nmi HLH 280 nmi HHH 380 nmi	8,000 lbs Air-to-air: Sidewinder 25mm gun Air-to-ground: MK-80 Series/LGBs, 1.7"/5" rockets, MK-20, CBU-59/78, MK-77, Maverick, Sidearm	Radar[3] NAVFLIR[4] NVG[4] ARBS Optical Laser Tracker Flares/Chaff	2 UHF (AM/FM) 2 VHF (AM/FM) Secure voice TACAN Inertial navigation system Radar[3]
EA-6B	4	Maximum level speed @ sea level: 550 kias w/extended stores 515 kias Cruise speed: 420 kias Maximum endurance speed: @ 10K 265 kias @ 20K 260 kias Time on station (2/200 nmi radius): 60 min Radius of action: 500 nmi	HARM Jamming pods Chaff Drop tanks	ALQ-99 ALQ-126A Flares Chaff	2 UHF 1 VHF 1 HF AM/FM scanner TACAN Automatic direction finder Inertial navigation system

KC-130	6	Maximum speed: 350 kias Cruise speed: 250 kias Maximum endurance speed: 240 kias Minimum speed: 105 kias Time on station: 13 + 00 Radius of action: 1,000 nmi Jet-assisted take-off	90,000 lbs 94 pax, 74 litters DASC(A) Refueling mode: 58,000 lbs Giveaway Parachute flares	Radar Homing and Warning ALE-39 Infrared Radiation Countermeasure Missile Warning Receiver Search Radar IFF Interrogator	
AH-1	2	Maximum speed: 190 kias Cruise speed: 130 kias Maximum endurance speed: 72 kias Time on station in CAS configuration: 1.8-2.4 hrs Radius of action: 100 nmi	Sidewinder Hellfire Sidearm 2.7"/5" Rockets Fuel air explosive 20mm turret gun 20mm gun pod	FLIR ALE-39 Infrared Radiation Countermeasure Laser Designator Radar Detector CW Warning Receiver	2 UHF (AM/FM) 2 VHF (AM/FM) TACAN Automatic direction finder FM homer Radar beacon
UH-1	3/4[5]	Maximum speed: 130 kias Cruise speed: 100 kias Maximum endurance speed: 55-65 kias Time on station 1 + 30 (30 + 10 best case w/auxiliary tanks) Radius of action: 89 nmi	1,400-1,800 lbs 6-13 pax, 6 litters 7.62mm .50 caliber guns 2.75" rockets	Radar Homing and Warning ALE-39 Infrared Radiation Countermeasure CW Warning Receiver Communications Jammer Loudspeaker for Psychological Operations	UHF/VHF/HF TACAN Automatic direction finder LORAN ASC-26 communications package (3 additional radios: 1 UHF/2 VHF) for airborne command and control